Engineering Research in a Cold Ocean Environment

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Presented to: The Canadian Research Management Association Annual Meeting, Halifax Nova Scotia, October 19, 1981

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The Centre for Cold Ocean Resources Engineering (C-CORE) was established at Memorial University of Newfoundland in St. John's, in 1975. Its initial funding was provided by the Devonian Group of Charitable Foundations of Calgary. This support is being supplemented by grants from governments and industry.

The Centre's mandate is to undertake research that will assist the safe and orderly development of Canada's resources in which cold and ice frequented oceans are a problem. C-CORE's main concentration of research is on ice, its properties, detection and behaviour.

ENGINEERING RESEARCH IN THE COLD OCEAN ENVIRONMENT

ABSTRACT

The safe and economic development of offshore and arctic resources require year-round operational capabilities. Engineering research on the behaviour of and the forces imposed by icebergs, and by solid and pack ice regimes involve costly, time-consuming programs. This paper considers some concepts for organization, management and implementation, the goal being effective technology transfer to design engineers of research results.

ENGINEERING RESEARCH IN THE COLD OCEAN ENVIRONMENT

We were invited to speak to you today on aspects of R & D in ice infested seas. It seems reasonable to assume that a meeting of the Canadian Research Management Association would be more interested in hearing about how we organize and manage the research we undertake than in being told about the technical content and results of our work. Accordingly, we shall concentrate today on this aspect and try to convey to you something of the philosophy underlying this venture.

Eight years ago this coming January a proposal was developed at the request of the Science Council of Canada for the establishment of a Centre for Cold Ocean Resources Engineering at Memorial University of Newfoundland. The proposal noted that:

> "In reviewing the totality of Canadian effort directed to the capability to operate within our cold and sometimes frozen ocean, it is not easy to define the gaps, for in the total mosaic of activities required, there are but very few pieces in place. It is clear, moreover, that completely new approaches, different from any employed hereto, may well be appropriate and necessary. Thus, we have advantages, for we are not yet committed through long experience to a simple extension of existing techniques."

The proposal went on to suggest that there was an important role to be played in Canada by an organization which could introduce and synthesize new approaches to engineering problems that were impeding ocean-related resource development.

The proposal was accepted. The Devonian Group of Charitable Foundations in Calgary made a substantial initial grant and C-CORE was established at Memorial University in St. John's in 1975. In the close to seven years that have elapsed since then, a good many of those missing pieces in the mosaic have

been identified and put in place, a number of them by C-CORE. During that comparitively short time, a significant effort has been mounted by government and industry to close the gaps and to find the engineering solutions required for safe and economic operations year-round in our northern offshore regions.

C-CORE was devised as an agent of change that could exert a catalytic role in this process. It could address some of the longer-term problems that industry is less easily able to tackle within the restraints of specific projects. It could also provide a means for coordinating and mobilizing resources from both government and industry in joint venture programs directed towards common objectives.

The concept of a sharp focus has from the beginning been central to C-CORE's approach. Its Constitution requires it to:

> "Concentrate its research activities on the solution of a limited number of carefully defined specific engineering problems that are clearly of national interest and of long-term concern to industry and government;"

Engineering is an applied science and engineers have to manage and carry through enterprises. They often have to do this in circumstances where it is far from clear exactly how their science should be applied - the data are just not available on which to base the technical decisions. When the reference books and design manuals are of little or no help, or even positively misleading, then it is necessary to set about systematically reducing the uncertainties and eventually removing them.

This is where the engineering researcher must, from the outset, establish clearly what are the key issues that face the builders and operators and thus the government regulators. This can best be done in close and regular consultation with them; indeed it is hard to see how it could be done otherwise. The

necessity to communicate and to stay relevant had a profound effect on the way in which the Centre was originally organized and it has been a dominant factor in its evolution since.

The Centre has a strong, independent Board of Governors. To quote again from C-CORE's Constitution:

> "C-CORE is a self-reliant organization of Memorial University which is owner of C-CORE's buildings and equipment and beneficiary of all its assets and liabilities. The Board of Governors is responsible for the funding, research activities policy direction and management of C-CORE."

At least two members of the Board are drawn from the industry Associates of the Centre and at least one member each must come from the Government of Canada, from the Government of Newfoundland and Labrador and from Memorial University's Board of Regents. Members of the Board are appointed by the President of Memorial. The Director of C-CORE is responsible to the President and to the Board of Governors.

C-CORE is not incorporated as a separate legal entity; it is part of Memorial University. This simplifies its affairs from a contractual and credit point of view. The Centre has the full weight of a large institution behind it and the flexibility that this provides. At the same time, an external board and external funding for its operations assure a considerable measure of independence of action. This form of organization offers the secure base of a university, but free of many restraints that restrict the activities of academic departments and research institutes funded from the univeristy's budget.

The main funding for the Centre is in the form of core grants from its industry Associates and from governments that flow through a Research Trust administered by the University and controlled by C-CORE's Board of Governors.

Additional funding is in the form of program support and contract revenue, with support in kind representing a further significant factor.

Almost exactly a year ago, the Captain Robert A. Bartlett Building was completed on Memorial's campus to house C-CORE and the Ocean Engineering Information Centre. Funded by a $1 million grant from the Provincial Government, this facility was envisaged as an international focal point for R & D in cold ocean engineering. The number and variety of the entries in our visitors' book since we moved into the building confirm that C-CORE is now able to function properly in its role as a centre.

We have referred to the need for a sharp focus and for concentrating our research on a few key issues. Let us now take a look at the decision-making process that we have evolved for arriving at these issues and for defining the projects to be undertaken. The original process of consultation with industry and governments in the Centre's early days highlighted the need to know much more about ice as an engineering material and about the behaviour of icebergs as they might affect engineering structures in the ocean or on the seabed. It also became clear that, in Canada's vast northern and offshore regions, remote sensing techniques offered the best means of securing the data we needed to increase our understanding of the processes involved. Accordingly, our main research thrusts have been directed towards learning more about sea ice in all forms and towards developing the means of identifying and monitoring ice and also oilspills.

The Research Program Advisory Committee of our Board of Governors reviews our Research Plan regularly and guides us in the selection of projects. The industry Associates of C-CORE meet annually with us in a Research Workshop for

the same purpose. However, good research was never ordained from the top down. Dr. C.E.K. Mees, the head of research at Eastman Kodak, wrote more than four decades ago:

> "The best person to decide what research work shall be done is the man who is doing the research, and the next best person is the head of the department, who knows all about the subject and the work; after that you leave the field of the best people and start on increasingly worse groups, the first being the research director, who is probably wrong more than half the time; and then a committee, which is wrong most of the time; and finally, a committee of vice-presidents of the company, which is wrong all the time.

This is a view that is widely shared by independent-minded research engineers and scientists - and of course these are the kind likely to come up with the new approaches and innovative solutions. Autonomy or self-direction is felt to be an essential condition for achievement. Obviously, this can only work in a group if the individual researcher and the group are marching to the same tune. When this is the case, a very productive creative tension can be established between the two.

The head of the Heath Government's "Think-Tank" in Britain, Lord Rothschild, reflected on the contrast between analytical thinking and, what he called, synthetic thinking - the power to make connections between disparate subject matters and problems which ordinary able analytical thinkers nad not associated in their thought. He wrote:

> "The thoughtful, original or inventive man is not the man who solves a complex problem elegantly and fast: but rather the person who changes the terms in which a problem is discussed in such a way that new lines of argument, connecting hitherto unrelated notions, are opened up."

What is challenging for a research group is how to attract that kind of individual to come and work with you for a while.

Researchers with originality are generally idealists who have personal long-range perspectives on technological development. They need to find the right motivation to unlock their full potential. One incentive is the opportunity to work in an interdisciplinary atmosphere where there is a focus on integrating the efforts of people with different but complementary disciplinary backgrounds. Perhaps this is because the very notion of a collaborative team effort between disciplines runs counter to the department and faculty organization of the modern university and the image of the lone independent investigator. This is also in contrast to multidisciplinary projects where the participants work on component problems relevant to their own discipline and there is coordination but no integration. In any event, we have found that these are important issues where good people are concerned.

In contrast to the faculty researcher who normally has to carry a heavy teaching load besides, our researchers are free to devote all their energies to research. A full-time group of this kind can, if properly supported, bring a considerable critical mass to bear on a set of problems. Its members can also grasp the opportunities which, from time to time, present themselves. These can challenge their entrepreneurial abilities by offering the chance to test a new concept or technology and, in the process, put together a joint venture package and the funding for it. This is good for the individual and, of course, good for the Centre.

From inception, C-CORE has emphasized the need for its researchers to get out into the field. One result was an early recognition that the instruments on which they had to rely often did not work in a cold ocean or Arctic environment. The Centre therefore began to adapt and improve existing equipment and eventually to develop new devices to meet its purposes. As this aspect of its operations

expanded, C-CORE began to look for a way to transfer this new technology into the private sector, preferably in Newfoundland. Last year, INSTRUMAR Limited was incorporated for this purpose as a wholly-owned subsidiary of C-CORE and Memorial. A few weeks ago, we successfully completed the process of separating it from the University and transferring it into the private sector where it is operating as a normal commercial venture. It is now wholly-owned by its staff, all nine of whom were previously employed by C-CORE. INSTRUMAR will continue to occupy space in our building, for which they pay a commercial rental, until next fall at which time the arrangement will be reviewed.

In 1978, C-CORE's remote sensing specialist group left to start up their own consulting company: REMOTEC Applications Inc. This venture, the formation of which was also encouraged and assisted by C-CORE, is based in St. John's and currently has a staff similar in size to our own. We feel that this kind of spinoff activity provides a means of transferring technology and of increasing the ocean engineering base without having to expand the size of the Centre. It is also a way in which to back entrepreneurial people with a record of success in research who are motivated to start up a new high-technology enterprise.

There is another important subject that is central to the conduct of research and that is information. Knowledge is both the essential raw material and also the end product of research. The quality of the input obviously controls the value of the output. Even if both are excellent, the results of any research have limited value unless they are disseminated. If the data and conclusions cannot be evaluated by others, the results must remain suspect until this process has occurred. This is, of course, a real problem in the case of site-specific work that may have to remain proprietary, at least for a time. However, there is increasing readiness by both governments and industry to expose the studies and research they commission in the public domain.

The Ocean Engineering Information Centre was set up as part of C-CORE at an early stage. It seemed to us crucial to ensure that our researchers would be supported by a high-quality in-house service which could respond rapidly to their needs and provide them with current scientific and technical information in the fields in which they were working.

The OEIC has built up a special collection of materials in the field of cold ocean engineering and a computerized key word index of its own and Memorial's holdings in our special fields of interest. This index is continuously updated and it is available in microfiche on subscription. The OEIC's monthly Bulletin, which lists new acquisitions and other useful information, is also issued on subscription. Although charges are made for services, the information resource is freely available to the local engineering community. A Data Bank is also administered by the OEIC in which we lodge the field and laboratory data from all our projects.

There is one other aspect of information on which we should touch and that is publications. We discovered quite quickly that there is no obvious journal in which to publish the results of applied cold ocean engineering research undertaken by an interdisciplinary group. Contract and data reports are not, in any event, in a form suitable for publication in the academic refereed literature. So we decided to publish our own material in order to make it available quickly. We have a publications committee that administers an internal review process of all C-CORE articles, papers and reports prior to publication. A relatively small number of each report are printed in hard copy and about a third of these are sent out to selected libraries, to centres of research and to the commercial abstracting services in the field concerned. Some C-CORE reports are available in microfiche. The Centre also publishes the quarterly C-CORE News and an Annual Report.

We have dealt at some length with information and publication services because they are so basic to a research operation. The administrative, financial

and other supporting services provided by the Centre have a lower profile, but they are equally vital. You must have and you must be seen to have financial control. There must be an effective interface with internal and external bureaucracies so that the researchers don't waste their time doing unecessary and usually inefficient battle with officialdom. The administration function has to be lean and future-oriented. Its main concern is to expedite today's job and to make tomorrow's easier.

Canada is poised on the threshold of vast investment in the development of its ocean frontier resources. During the current decade, researchers in industry, governments and universities will be challenged by a wide variety of new problems, the solutions to which will be required most urgently. Their work must be characterized by relevance, quality and courage.

There are two more quotations to bring these remarks to a close. The first is from Machiavelli who lived in the fifteenth century. He wrote:

> "There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things, because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new."

And the second is attributed to Marshall McLuhan's son, who said of his father:

> "He had an inclination to travel fast and light, otherwise he felt you spend all your time administering and never get anything done yourself."

There is a lesson from each for all researchers and especially for all managers of research.